ECE 343: Signals and Systems

Test 3: Discrete Time LTI Systems and Z-Transforms

1. A system is governed by the difference equation $y[n] + y[n-1] = (x[n])^2$.

   (a) Find the impulse response. Is it useful?

   (b) Find $y[n]$ for all n when $x[n] = \cos(\omega n)$.

2. An LTI system is governed by the difference equation $y[n] = \alpha y[n-1] + x[n]$. Let $x[n] = 2u[n]$. Find all $\alpha \in (0,1)$ so that $y[1] \geq 1$. The system is in a relaxed state ($y[n] = 0$ for $n < 0$).

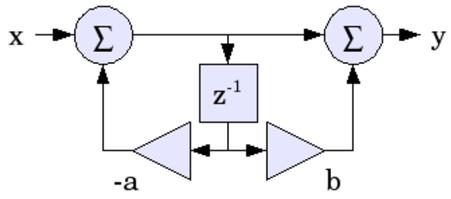
3. Consider the difference equation $y[n+2] + \frac{1}{2}y[n+1] - \frac{1}{2}y[n] = x[n+1] + x[n]$.

   (a) Find the impulse response and the transfer function.

   (b) Is the system described by this equation causal? Is it BIBO stable?

   (c) Find $y[n]$ for all $n \geq 0$ when $x[n] = 4^{-n}u[n],\ y[-1] = y[-2] = 1$.

4. Write down the transfer function of the system implemented in the diagram below.



5. (Bonus) Find the equivalent resistance of the infinite resistor network shown. All resistors have the same value (call it R). *Hint: Recast it as difference equation.*